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A-9

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
08/998,264	12/24/97	ARMAND	UTSB-646

IM52/0715

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1745 ART UNIT PAPER NUMBER

07/15/99
DATE MAILED:

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary	Application No. 08/998,264	Applicant(s) Armand et al.
	Examiner Carol Chaney	Group Art Unit 1745

Responsive to communication(s) filed on 4-21-99

This action is **FINAL**.

Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire three month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

Claim(s) 1-61 is/are pending in the application.

Of the above, claim(s) 1-22, 24, 50-59, and 61 is/are withdrawn from consideration.

Claim(s) _____ is/are allowed.

Claim(s) 23, 25-49, and 60 is/are rejected.

Claim(s) _____ is/are objected to.

Claims _____ are subject to restriction or election requirement.

Application Papers

See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

The drawing(s) filed on _____ is/are objected to by the Examiner.

The proposed drawing correction, filed on _____ is approved disapproved.

The specification is objected to by the Examiner.

The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

All Some* None of the CERTIFIED copies of the priority documents have been

received.

received in Application No. (Series Code/Serial Number) _____.

received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____.

Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

Notice of References Cited, PTO-892

Information Disclosure Statement(s), PTO-1449, Paper No(s). 5 and 10

Interview Summary, PTO-413

Notice of Draftsperson's Patent Drawing Review, PTO-948

Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

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Election/Restriction

1. Applicant's election without traverse of the invention of Group IV (claims 23, 25-49 and 60) in Paper No. 9, filed 4-21-99, is acknowledged.

Claim Objections

2. Claims 25-27 and 60 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 23 limits 'M' to Fe²⁺, Mn²⁺, or mixtures thereof. The inclusion of cobalt or nickel as 'M' in claims 25-27 further broadens claim 23, rather than further limiting the claim.

Claim 60 recites a compound Li_{2+x}NaV₂(PO₄)₃ as a cathode material. Claim 60 is ultimately dependant upon claim 23 which does not include sodium containing materials as the cathode material.

Claim Rejections - 35 USC § 112

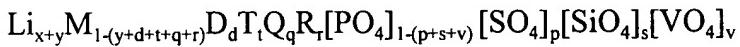
3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

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4. Claims 23, 25-49 and 60 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Applicants' specification fails to enable one of ordinary skill in the art to make the cathode material:



without undue experimentation for at least the following reasons:

1) Applicants' specification provides no clear examples of the modified olivine structures *as claimed*. Example 2 is described as an example of a modified olivine structure, and the example discloses the preparation of the compound $\text{Li}_{1.1}\text{Fe}_{0.8}\text{TiP}_{0.8}\text{Si}_{0.2}\text{O}_4$. However, this compound does not meet the limitations of claim 23. Using the nomenclature of Claim 23, the compound disclosed in Example 2 may be written as:



which should correspond to the formula



The iron in the Example 2 compound corresponds to the sum of 'M' and a portion of 'T'. The titanium in the Example 2 compound corresponds to the sum of 'D', a portion of 'T' and 'Q'. Other values in the Example 2 compound formula correspond with variables in the Claim 23 formula as follows

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- 1) $s = 0.2$
- 2) $p = 0$
- 3) $v = 0$
- 4) $x + y = 1.1$
- 5) $r = 0$

Since the total amount of iron in $\text{Li}_{1.1}\text{Fe}_{0.8}\text{Ti}(\text{PO}_4)_{0.8}(\text{SiO}_4)_{0.2}$ is either available as 'M' or 'T' it follows that

6) $1 - (y + d + t + q + r) + nt = 0.8$ where 'n' is the fraction of 'T' in the compound which is iron. ('n' must range from 0 to 1.)

The total amount of titanium in $\text{Li}_{1.1}\text{Fe}_{0.8}\text{Ti}(\text{PO}_4)_{0.8}(\text{SiO}_4)_{0.2}$ is available as: 'D'; a portion of 'T' given by $1-n$; and 'Q'; therefore

$$7) \quad d + (1-n)t + q = 1$$

Adding equations 6 and 7

$$8) \quad 1 - y - r = 1.8 \text{ or, since } r=0,$$

$$y = -0.8$$

This is inconsistent with the limitation of claim 23 that $0 \leq y \leq 1$ and the compound disclosed in Example 2 does not meet the limitations of claim 23.

In considering the other examples in applicants' specification, Example 1 discloses an ordered olivine compound, which is considered distinct from the modified structures claimed and Example 3 discloses a NASICON-structure compound, a non-elected invention.

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2) Although applicants' specification states on page 4 that: "It is also *envisioned* that the pristine olivine structure may be modified on both anionic and cationic sites" (emphasis added) guidance on how such modifications should be made is not provided to one of ordinary skill in the art. For example, guidance as to starting materials, preparative techniques (calcination, aqueous precipitation, ion-exchange, electrochemical synthesis, etc.) and experimental conditions such as temperatures, times, pressures, etc. to produce applicants' cathode materials as claimed are not provided. The state of the art does not discuss olivine structures which include both cationic and anionic modifying moieties, but typically discloses either modification of the cationic sites or the anionic sites. For example, Shackle, (US Patent 5,721,070) Kariru, (JP 11-025983) and Okata et al. (JP 09-134724) disclose olivine compounds as cathode materials for lithium batteries, but do not include structures with modifications of both the cationic and anionic frameworks.

3) Applicants' cathode compound



is recited in terms of 9 variables (x, y, d, t, q, r, p, s, and v) but 4 equation relating the variables. One of ordinary skill in the art could not make a compound with a stoichiometry satisfying the limitations applicants' claim 23 without undue experimentation, since values for the 9 variables cannot be determined.

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

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Claims 23, 24-49 and 60 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claim 23, the description of the cathode compound is incomplete because y, t, q, r, p, s and v are defined as the *fractions* of a given species of ion on a particular crystallographic site. However, since the locations of the remaining quantities of these ionic species are not given, the description of the material is incomplete. For example, if d=0.2, and represents "the fraction of divalent ions on the initial Fe⁺² sites", the location of the fraction of divalent ions (presumably 0.8) *not* on " the initial Fe⁺² sites" is not stated

Claim 23 recites the limitations "the initial Fe⁺² sites" and "the initial P⁺ sites" in lines 22-30. There is insufficient antecedent basis for these limitations in the claim, since a structure which has initial Fe⁺² and P⁺ sites is not recited.

Claims 27, 29, and 34 appear to assign a plurality of meaning to the variable 'x' and are therefore indefinite.

Claim 40 is indefinite because ionic conductivity is temperature dependant, but temperature is not recited in the claim.

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Claim Rejections - 35 USC § 102/103

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claims 23, 25, 28, 30 and 31 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Shackle (US Patent 5,721,070).

Shackle discloses compounds of the form $M_xT_yA_z$ where M is an alkali metal ion, T is a metal ion with a plurality of stable oxidation states, and A is a multi element anion such as silicate, titanate, and manganate as cathode active materials. Among the compounds disclosed by Shackle is $LiMn(VO_4)$ which corresponds to applicants' compound



when y, d, t, q, r, p, and s are 0; x=1 and v=1 (Note column 5, lines 10-31.)

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Mixing carbonaceous, electronically conductive materials with the cathode active materials is also taught by Shackle. (Note column 3, lines 18-24.)

The ranges of compounds disclosed by Shackle differs from the range of compounds disclosed by the applicants. However, the classes of compounds disclosed by Shackle and by the applicants overlap. Specific compounds disclosed by Shackle such as LiMn(VO₄) anticipate applicants' claimed compounds, or, in the alternative, the claimed compounds would have been obvious to the skilled artisan based upon the disclosure of Shackle.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Amine, in JP 11-025983 discloses lithium metal phosphate olivine structures as cathode materials.

Okada et al., in JP 09-134725 disclose cathodes containing iron mixed oxides such as lithium iron phosphate and lithium iron vanadate.

Padhi et al., in *J. Electrochem. Soc.*, Vol 144, No. 4 disclose phospho-olivines as positive electrode materials for lithium batteries.

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10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Carol Chaney whose telephone number is (703) 305-3777. The examiner can normally be reached on Monday-Friday from 8:00 am to 4:30 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ms. Maria Nuzzolillo, can be reached on (703) 305-3776. The fax phone number for the organization where this application or proceeding is assigned is (703) 305-3599.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Carol Chaney
Patent Examiner
Art Unit 1745
June 28, 1999